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Psychological Factors Determining Individual Compliance with Rules for Common Pool Resource Management: The Case of a Cuban Community Sharing a Solar Energy System

Annette Jenny · Fernando Hechavarria Fuentes ·
Hans-Joachim Mosler

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Abstract This study focuses on individuals' subjective reasons for complying with rules for common pool resource management. We examine the topic of individual rule compliance, which the commons literature has addressed only marginally, and outline recent empirical findings. Hypotheses are derived based on rule compliance theory and explored using data gathered in a Cuban community sharing a solar energy system. The statistical analyses reveal that compliance with rules for energy management is influenced by various factors. Depending on the particular rule, factors such as sanctioning, legitimacy, and compatibility, among others, influence the frequency of individual rule compliant behavior to differing extents.

Key words Rule compliance · common pool resource · multiuser system · psychology

Introduction

In regulating use of common pool resources, rules are regarded as an important mechanism for avoiding individ-

ual overuse and resource degradation (Ostrom, 1990; Ostrom *et al.*, 1994). Some of the literature on common pool resource management contains more or less explicit assumptions of conditions that have to be met for individuals to comply with rules. The theoretical tradition following Hardin's "Tragedy of the Commons" (1968) and related models argue that humans are rational and egoistic actors who will deplete a resource if no coercion of any sort is applied, preferably by public authorities. However, there are a vast number of studies demonstrating that local communities worldwide have been able to establish sustainable management systems and avoid the "tragedy" (Baland and Platteau, 1996; Bender, 2002; Cardenas *et al.*, 2000; Hoffmann, 2004; Lu, 2001; McCay and Acheson, 1987; Ostrom, 1990; Trawick, 2001; Wade, 1988; White and Runge, 1995). Local knowledge of the characteristics of the resource and the specific conditions often found in traditional small-scale groups (such as group homogeneity) create favorable conditions for self-management (Agrawal, 2001a,b). Authors following this "self-management perspective" emphasize the importance of strong community norms and participation or—if a certain degree of external involvement in management policy is accepted—"co-management" by local users when establishing rules (Jentof and Kristoffersen, 1989; Nielsen, 2003; Ostrom, 1998, 2000). Besides such discursive compliance mechanisms (Honneland, 1999), coercive mechanisms inducing compliance are maintained in the self-management perspective when rules are monitored and violators sanctioned, although often by the community itself and not by public authorities.

While the studies mentioned above imply assumptions of how compliance can be achieved, other studies have focused more explicitly on how individual compliance can be explained psychologically. The present paper starts out by examining theoretical and empirical findings on the

A. Jenny (✉)
Division of Social Psychology, Department of Psychology,
University of Zürich, Plattenstrasse 14,
CH-8032 Zurich, Switzerland
e-mail: ajenny@sozpsy.unizh.ch

F. Hechavarria Fuentes
Departamento de Electrificación Rural, Centro de Investigaciones
de Energía Solar (CIES), Santiago de Cuba, Cuba

H.-J. Mosler
Department of Systems Analysis, Integrated Assessment and
Modelling (SIAM), Swiss Federal Institute for
Environmental Science and Technology (EAWAG),
CH-8600 Dübendorf, Switzerland

topic of individual rule compliance. Based on the findings, we derive hypotheses for our own research on the case of a Cuban community managing their commons, which we test statistically.

Determinants of Individual Rule Compliance

Models of individual rule compliance integrate factors from economic, psychological, and sociological theories (Honneland, 1999; Nielsen, 2003; Sutinen and Kuperan, 1999; Thibaut *et al.*, 1974). Economic models, such as Becker's "General Deterrence Model" (1968), take an instrumental perspective that assumes that individuals react primarily to the rewards and costs of compliance behavior. Deterrence through high *sanctioning costs* continues to be an important instrument to enforce compliant behavior in various contexts (in traffic law enforcement, for example). The effects of sanctioning costs result from the perceived probability of being detected and the severity of the expected sanctions (Diekmann, 1980; Gelau, 2001; Karstedt, 1993). The effectiveness of the one factor is believed to be dependent on the other, as neither of them is effective on its own. Mathematically, sanctioning costs can be calculated as the probability of being detected multiplied by the severity of the sanctions (Opp, 1971). Compliant behavior, therefore, can be enforced by increased surveillance and increased sanctioning severity. This view corresponds to the rational-choice tradition of viewing resource management (Hardin, 1968), which sees constraints and surveillance as the only means for controlling individual behavior and preventing resource degradation. This economic perspective has important restrictions, however: overall surveillance is often not possible, and large-scale monitoring systems are very costly. Additionally, people still find ways to avoid controls and evade the rules. Psychological and sociological theories of rule compliance integrate individual and social factors: *Personal morals*, *social norms*, and *legitimacy* of rules are non-instrumental determinants of compliance behavior (Gezelius, 2004; Honneland, 1999; Sutinen and Kuperan, 1999; Thibaut *et al.*, 1974).

Rule compliance can follow a personal feeling of moral commitment to "do the right thing." The importance of morals in adherence to social rules has been widely examined (see, for example, Kerr *et al.*, 1997; Kohlberg, 1976). A study of rule compliance in fisheries (Sutinen *et al.*, 1990) showed that despite the possibility of high illegal gains, fishermen chose to show compliant behavior because they wanted to do the right thing. Other studies (such as Pfeiffer and Gelau, 2002) identified a "general norm orientation"—a general normative disposition to follow rules—that had a positive effect on compliance with traffic rules.

The behavior of others also influences individual behavior. *Social norms*, or notions of what most people

perceive as adequate in a certain situation, exert a kind of a social pressure, because ignoring such norms could be sanctioned by others (Reno *et al.*, 1993). Several studies of rule compliance in common pool resource systems have revealed that individuals adjust their behavior to the behavior of their social group (Eggert and Ellegard, 2003; Mosler and Brucks, 2003; Nielsen and Mathiesen, 2003). The perception of the *legitimacy* of rules is a further factor influencing compliance. The topic of legitimacy has been addressed by justice researchers analyzing the role of *distributive justice*, *procedural justice*, and *interactional justice* in organizational settings (Colquitt *et al.*, 2001; Tyler, 1994; Tyler and Blader, 2000). Distributive justice describes the fairness of the distributional effect of rules. Some theories claim that people demand equity rules (Adams, 1965; Walster *et al.*, 1976, 1978), meaning that their expectation of receipt is proportional to what they have invested. Other forms of distribution rules are equality rules (everybody receives the same) or rules distributing according to individual needs (Leventhal, 1976). Which distributive rule is preferred depends on individual, contextual, and cultural factors (Allison, 1990; Allison *et al.*, 1992; Fiske, 1990; Hofstede, 1980; Mannix *et al.*, 1995; Van Dijk and Wilke, 1995; Van Dijk *et al.*, 1999). People are more likely to obey rules that have the desired distributional effect (Colquitt, 2001; Colquitt *et al.*, 2001).

Procedural justice describes the fairness exercised by the authorities imposing rules and the fairness of the rule development process (Thibaut and Walker, 1975). Many different criteria of procedural justice have been introduced, such as "process control" and "decision control" (Thibaut and Walker, 1975), or "consistency", "bias suppression", "accuracy of information", "correctability", "ethicality", and "representation" (Leventhal, 1980; Leventhal *et al.*, 1980). These are attributes that describe desirable participative, democratic, transparent, and ethical elements in the rule development process. Interactional justice (Bies and Moag, 1986; Shapiro *et al.*, 1994) additionally describes the degree of interpersonal fairness, meaning the respect and politeness shown to people by the authorities imposing rules, and the degree of informational justice, or the perceived transparency and adequacy of information in the rule development process. Rule compliance has been found to occur more often when rules are legitimate in the sense of these forms of justice (Colquitt, 2001; Colquitt *et al.*, 2001).

Contextual factors must also be considered when discussing rule compliance. Rules should be compatible with local conditions. Only rules that do not interfere strongly with livelihood strategies are likely to be obeyed (Horning, 2000). Similarly, rules should be perceived as *adequate*—their necessity and their protective function in resource systems should be apparent (Nielsen, 2003). Habits or routines can impede the adoption of new be-

haviors, but they can also strengthen them once new behavior is adopted (Honneland, 1999). Compliance behavior must become routine; the obedience of new rules should break old behavioral habits. Other external factors (such as the possibility of access to markets) can have an effect on compliance behavior if people depend on a resource for economic outcome. Monetary incentives can lead to increased non-compliance (Horning, 2000; Marquette, 1998).

These findings correspond to findings in common pool “self-management” and “comanagement” perspectives (Agrawal and Goyal, 2001; Ostrom, 1990) that emphasize the importance of norms, participation, and consideration of local conditions for well-functioning community management. But they also show that some coercive measures (sanctioning) are often necessary for maintaining the rules. Table I shows factors that are considered to be determinants of individual compliance behavior.

So far, we have mentioned several psychological factors that have proved to have an influence on individual rule compliance in different contexts. Most of the determinants have also been found to be important in resource management systems where rules for use regulation have been applied. Most studies have used qualitative methods to explain rule compliance, whereas quantitative studies are still rare. Our case study includes quantitative statistical analyses in order to yield the psychological factors and evidence of the extent to which these factors determine individual compliance with rules for resource management.

Hypotheses

Our hypotheses focus on the factors in Table I that are marked with an (×) and on additional assumptions concerning these

factors for further explanations. Accordingly, our hypotheses were the following:

- I. Individual compliance with a rule is influenced by
 - a) sanctioning costs
 - b) general norm orientation
 - c) social norms
 - d) distributive justice
 - e) procedural justice
 - f) interactional justice (interpersonal and informational justice)
 - g) compatibility
 - h) adequacy
- II. For an extended explanation, we assume that:
 - i) the individual's perception of *sanctioning costs* is based on the perceived possibility of non-compliant behavior being detected and the severity of the expected sanctions
 - j) perceived *compatibility* depends on household characteristics (such as daily routines)
 - k) perceived *adequacy* of rules depends on the perceived state of the resource.

Research Setting and Methods

Description of the Community and the Solar Energy System

The common pool resource in this case study is shared solar energy provided by a photovoltaic (PV) system; these systems are also called also multiuser systems (MUS). MUS can provide energy to 200–400 households (Mitjá *et al.*, 2003). Although solar energy is a renewable and unlimited resource, the system size (number and quality of the PV panels) and storing capacity (number and quality of batteries) determine the amount of electricity produced and stored and set limits on consumption. This means that the users cannot consume as much power as they want as they have to consider the needs of other users. Additionally, inverters (technical devices converting AC to DC current for the use of household appliances) limit the amount of energy that can be demanded at any particular time. General overuse leads to the depletion of the stored energy, and too high simultaneous energy demand leads to system failures (inverter disconnections), leaving all the users without electricity. Rules for energy management, therefore, are crucial for communities using shared solar energy systems. As individual misbehavior has consequences for the whole community, individual compliance with rules for use regulation is important.

The Cuban community investigated, the village of Santa Maria del Loreto (650 m above sea level), is located 20 km from the municipal city of Songo, La Maya district, and

Table I Determinants of Individual Rule Compliance (Factors Marked with “×” Are Included in the Following Analysis)

Economic factor	Sanctioning costs (×)
Personal factors	Personal morals General norm orientation (×)
Social norms	Social norm (×)
Legitimacy	Distributive justice (×) Procedural justice (×) Interactional justice (×) (Interpersonal and informational justice)
Contextual factors	Compatibility (×) Adequacy (×) Routines External factors

50 km from the provincial capital Santiago de Cuba. The village has 156 residents living in 42 family households (Díaz López *et al.*, 2002). The main source of income is agriculture, as most of the residents work on coffee and flower plantations. Because everything is state owned, the workers receive only a minimal wage and cannot trade these agricultural products privately. For personal needs, they breed stock and cultivate vegetables and other crops, which—if there is a surplus—they trade within the village and in neighboring communities. Not everybody has this additional source of income, so that despite equal state wages, actual income is heterogeneous. The community has its own primary school, a small shop, a plant for coffee processing, and a community hall. A doctor responsible for the residents of Santa Maria and the neighboring villages stays in Santa Maria during the week.

For 15 years prior to the installation of the MUS, the village received electricity from a diesel plant that provided energy for two to three hours per day. In 1997 the plant was replaced by a MUS with a maximum output of 10 and 6 kW of inverter power (3 inverters of 2 kW) (Díaz López *et al.*, 2000; Ramos *et al.*, 1998). The system was donated by two nongovernmental organizations, Sol para Cuba (Austria) and Cubasolar (Cuba), and the coordinating institution was Centro de Investigaciones de Energía Solar (CIES), Santiago de Cuba. The community was chosen for this electrification project because it met important geographical and social conditions for installing MUS: the houses are situated close together as required by an electricity main system, and the social intimacy and transparency of the community was regarded as advantageous for the sharing of an energy supply system. A meeting was held to inform the community about the project and about solar energy. The advantages of the system over the existing diesel generator were explained, and the community was invited to ask questions. The community then decided in favor of the installation and helped with the construction work. The system provides electricity to 42 households of Santa Maria and seven households of the neighboring village, El Triunfo. Maintenance and continuous monitoring is performed by CIES. The village mayor of Santa Maria was employed for smaller maintenance tasks and for monitoring the system and energy consumption of the residents. He was chosen for these tasks because he has an educational background as technician and had been the leader of the village for several years. He receives a small wage from the National Electricity Company and from the community. The users pay 0.2 Cuban pesos (27 pesos = US\$ 1) per kW as a contribution towards maintenance costs and towards the wages for the mayor.

Electricity is used for private and public lighting, electrical appliances in the households, and public facilities. When the MUS was installed, all households received three

energy-saving light bulbs (15 W), two fluorescent lamps (20 W), and a small radio (8 W). Energy consumption rose over time, as people bought new appliances, such as televisions, mixers, electric rice cookers, and even refrigerators. Parallel to this, due to technical problems in the years 2001–2003, three originally installed inverters of 2 kW each had to be replaced with one inverter of only 4 kW. Additionally, people gradually replaced energy-saving light bulbs and the fluorescent bulbs with normal light bulbs, because energy-saving bulbs are rarely sold in the markets and fluorescent bulbs are expensive. These circumstances—reduced inverter power and rising energy consumption—led to system failures due to simultaneous consumption peaks. The introduction of use rules became necessary.

Rules for Energy Management

With growing energy consumption, the risk of general overconsumption and particularly of simultaneous consumption peaks has increased over the years. Up to now enough energy could be stored thanks to a big battery bank. The reduced inverter power, however, has led to moments of short energy supply with system disconnections caused by high simultaneous energy demand. In order to avoid high demand peaks, but also to reduce energy consumption generally, four energy use rules, in stages, were introduced (Jenny *et al.*, 2004):

1. No use of irons and washing machines
2. No use of light bulbs of 40 W or more
3. Appliances with high energy consumption (such as mixers, hair dryers, rice cookers, etc.) should only be used during the day (preferably midday) and not in the evenings
4. Refrigerators have to be disconnected from 6 p.m.–10 p.m.

The first rule was introduced when the system was installed. CIES Calculations confirmed that the system could not provide sufficient energy to allow individual use of irons and washing machines. Also, these appliances have high start up currents, that is, high instantaneous power, which requires relatively high inverter power. Therefore CIES suggested prohibiting the use of such appliances and the villagers were strongly advised to adopt the rule, which they did. Although at the beginning the community only used energy-saving light bulbs, a lack of supply in the market gradually led to replacement with normal light bulbs. After the reduction of inverter power, the use of normal light bulbs of up to 100 W led to many system disconnections due to high instantaneous power. A donation of energy-saving bulbs by the local government and the introduction of the second rule by the villagers improved the situation. Light bulbs and fluorescent bulbs of 40 W or more have been prohibited for everybody.

The third and fourth rules were introduced after people began buying the appliances listed. Again, high simultaneous consumption peaks caused system failures, so it was agreed that owners of these appliances should use them only during the day, when general consumption is low. Apart from the strong advice from CIES to introduce the first rule, the village of Santa Maria has independently developed rules for managing energy distribution. The village mayor became the most important person in the process of introducing and enforcing new rules: He developed great experience over the years and he normally proposes and communicates new rules. If he thinks a new rule is necessary that affects the whole community (such as rule 2), he arranges a community meeting to inform everybody about the necessity of a new rule and invites everybody to discuss the proposition. If only some households have to know a rule (such as rules 3 and 4), because they possess appliances requiring restrictions, the village mayor personally advises them. The mayor also monitors adherence to the rules and identifies rule breakers by observing households, visiting door-to-door and, occasionally, with the help of other inhabitants who think they know who the rule breaker is. Rule breakers are warned, and if they repeatedly fail to obey the rules, they are sanctioned by having their electricity supply cut off for several days. Such repeated rule breaking, however, has only occurred few times up to now. Rule breaking sooner or later becomes publicly known and talked about in the community. Since rule compliance is a crucial issue in the village, it is a frequent subject of conversation and gossip. However, the village mayor is officially in charge of the decision-making where energy related issues are concerned.

Methods

In January 2004, we conducted face-to-face interviews with key persons in the community and representative family members of all households of Santa Maria and El Triunfo that are provided with electricity by the MUS. The interviews were based on a questionnaire tapping information about household characteristics, perceptions of system performance, and individual compliance behavior. Taking into consideration that cultural background influences response behavior, the questionnaires were tested carefully by local social scientists. Also, locals conducted the interviews in order to elicit reliable data. The interview participants were invited to answer and discuss the questions spontaneously. The answers were then rated on a scale, which the participants had to confirm. Additionally, all comments made by the interview participants were recorded. This procedure allowed the generation of qualitative and quantitative data. Table II shows the data

collected from all households. All variables are listed as well as item examples.

The interview first gathered information on household characteristics, such as the number of people, electrical appliances in use, and daily routines and habits. This gave us an idea of how people live and work and how they spend their free time. Participants were then asked about their perception of the state of the resource, that is, how much energy was available at the time and how often they experienced system failures. This information was rated on scales. The participants were then presented with the existing rules for energy management and asked if they were aware of these rules. If this was the case, the interview continued with questions about the factors determining rule compliance. Each rule was evaluated with items measuring perceptions of the sanctioning system, the households' general norm orientation, the perceived social norm, the legitimacy (distributive, procedural, interactional justice), compatibility, and adequacy of the rules. For every rule, the overall sanctioning costs, the probability of being detected, and the severity of sanctions had to be rated on scales. To measure the family's general norm orientation, participants were asked if their family considered rules as necessary for community life. As a constant trait, this led to one single value as opposed to separate values for each rule. Participants were also asked about their perception of the strength of a social norm of obedience to each of the rules: this was measured by asking how they perceived the compliance behavior of the other community members.

The issue of legitimacy included variables about the distributive effect of the rules, participation in the rule development process (procedural justice), and the transparency of the rule development process (informational justice). Distributive justice was rated in general, that is, the distributive effect (how energy is distributed in the community) of the whole rule system had to be judged (single value). The interviewees were asked if participation was possible and if they obtained transparent and adequate information. Questions about the treatment of people (interpersonal justice) by the village authority (mayor) who enforces the rules were excluded for political reasons.

Questions about contextual factors included variables measuring the perceived degree of compatibility of each rule with daily life. Further, we wanted to find out what participants thought about, whether the rules were adequate for protecting the resource. Information about the actual compliance behavior of each household was obtained from the household members themselves and from the village mayor who monitors energy use by the community and knows about the individual rule compliance of all households. Regression analyses were then carried out, which provided information as to how much variance of rule compliant behavior can be explained. This reveals which

Table II Data Collected from All Households of Santa Maria; Variables and Item Examples

	Variable	Item (example)
1. Household characteristics	Socio-demography	Number of members, gender, occupation of each member
	Load data	Number, type, and power of each appliance
	Habits and activities	Presence times at home, social activities
2. Perception of the state of the commons	System failures	How often did system failures occur in the last weeks?
	Available energy	How much energy does the solar energy system produce at the moment?
3. Rules for energy management	Knowledge of each rule	Do you know this rule?
4. Rule compliance	Sanctioning costs	As how hard do you consider the sanctions?
	General norm orientation	As how important do you consider the rules for achieving an ordered community life in your village?
	Social norms	How often have the other inhabitants of your community followed the rule in the last 12 months?
	Distributive justice	Do you think energy is distributed just in your community?
	Procedural justice	To which extent were you allowed to participate in the rule development process?
	Interactional justice (informational justice)	To which extent did you receive transparent information about the reasons why the rule should be introduced?
	Compatibility	How strongly does the rule limit you in your daily activities?
	Adequacy	In a how great extent do you think the rule helps to prevent system failures and resource shortages?
	Actual compliance	How often have you followed the rule in the last 12 months?

variables, and to what extent, determine individual differences in the frequency of rule compliant behavior. Additionally, perceptions of the state of the commons were correlated with the perceived adequacy of the rules. The assumption is that a rule is perceived as more adequate the fewer problems there are with the solar energy system (such as system failures). Correlations were also calculated to compare households having different characteristics and perceptions of rule compatibility. We assume that the perceived compatibility of a rule with everyday life is influenced by various household characteristics (such as the demographic composition of the family and its daily routines).

Results

Knowledge and Compliance

Before addressing the hypotheses, let us look at the level of knowledge of the rules and the actual frequency of rule compliance for each rule. All households are affected by the

first (prohibition of irons and washing machines) and second rule (prohibition of light bulbs of more than 40 W). And indeed, all households except one are aware of the first rule. Two households claimed that they did not know about the second rule. Sixteen households possess high-energy appliances and should therefore know about the third rule (use of appliances with high energy consumption only during the day). This is the case, as all of these households claimed to be aware of this rule. Interestingly, most of the other households also know this rule, even though it does not apply to them. The fourth rule (disconnection of refrigerators during the evening) is of relevance for one private household and the doctor's house only, as they are the only ones with a refrigerator. Both of these parties know the rule, and, again, most of the other residents have also heard about the rule. During the period that the interviews were conducted, people followed the rules. To obtain information on average rule compliance behavior, we asked about their behavior over the previous 12 months. Table III shows the frequency of compliance with each rule.

Table III Frequency of Compliance (Percentage) with the Rules in Santa Maria

Frequency of compliance	Rule 1 (<i>n</i> = 48)	Rule 2 (<i>n</i> = 47)	Rule 3 (<i>n</i> = 16)	Rule 4 (<i>n</i> = 2)
Always	100	64	31	0
Most of the time	0	18	37	50
Seldom	0	14	25	50
Never	0	4	7	0

So far, everybody has obeyed the rule forbidding the use of irons and washing machines, as the village mayor confirmed. The second rule (prohibition of light bulbs of more than 40 W) has been followed by 64% of the households that claimed to be aware of the rule; 18% reported they obeyed the rule most of the time, and 14% followed the rule only seldom; 4% reported they have not complied with it at any time. Sixty-eight percent of the households affected by the third rule (use of appliances with high energy consumption only during the day) obeyed the rule always or most of the time, 25% have seldom complied with the rule, and 7% have never obeyed it. The village member and the doctor affected by the fourth rule (disconnection of refrigerators during the evening) followed the rule most of the time or seldom.

Factors Influencing Individual Rule Compliance (Hypothesis I)

The hypothesis is that sanctioning costs, general norm orientation, social norms, perceptions of legitimacy (distributive, procedural and interactional justice), and contextual factors (compatibility, adequacy) influence rule-compliant behavior. It can be assumed that the influence of each factor varies depending on the rule. The statistical analysis will reveal which factors are of importance for compliance with each rule. Each of the four rules is analyzed separately.

Rule 1: No Use of Irons and Washing Machines

There is no variance in compliance behavior for this first rule. So far, everyone has followed this rule. Regression

analysis cannot be calculated, because there is no variance in individual behavior to be explained. It is interesting, however, that this is the only rule where non-compliant behavior does not occur. A comparison of the variables' statistics might reveal some of the reasons (Table IV).

Compared to the other rules, the first rule is seen on average as less legitimate, less adequate, and more incompatible, which would be reasons for attempts to break it. But the interviews also show that the sanctioning costs of breaking this rule compared to the other rules are rated higher. Also, the social norm of obeying the rule prevails.

Rule 2: No Use of Light Bulbs of 40 W or More

Differences in compliance behavior among households for rule 2 allow a regression analysis to be calculated. Table V shows the model with all explanatory (independent) variables included.

The model is able to explain 57% of the variance in frequency of compliance with rule 2. Sanctioning costs, distributive and informational justice, and compatibility statistically ($*p \leq 0.05$, $**p \geq 0.01$) appear as significant factors influencing individual rule compliance. Households who perceive the rule as compatible with everyday life more often show compliant behavior than households who rate the rule as incompatible. Those households break the rules more often. This variable is the strongest determinant of rule compliance (as is indicated by the β -value). People who perceive the development process of this rule as fair in terms of informational justice (adequate and transparent information) and think that energy is generally distributed fairly in the community obeyed the rule more often. The

Table IV Mean Values of Each Factor and Rated for Every Rule

	Rule 1		Rule 2		Rule 3		Rule 4	
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
Sanctioning costs	1.7	0.7	2.2	0.6	3.1	0.9	3	0
Social norm	2.7	1.2	3.5	0.9	3.8	0.8	3.5	0.7
Procedural justice	3.8	1.1	3.1	1.2	2.9	1.1	3.2	2.1
Informational justice	2.2	1.2	2.2	1.1	1.8	0.9	1.5	0.7
Adequacy	2.3	0.8	1.8	0.7	2.0	0.5	1.6	0.7
Incompatibility	2.7	1.2	3.5	0.9	3.8	0.8	3.5	0.7
Routine barriers	–	–	–	–	4.1	0.6	3	0

General norm orientation: $M = 1.8$ ($SD = 0.7$); Distributive justice: $M = 2.0$ ($SD = 1.5$)
Min = 1, Max = 5; Coding:
1 = very high, 5 = very low;
 $n = 48$ (rule 1), 47 (rule 2),
16 (rule 3), 2 (rule 4)

Table V Regression of the Independent Variables “Sanctioning Costs,” “General Norm Orientation,” “Social Norm,” “Distributive Justice,” “Procedural Justice,” “Informational Justice,” “Compatibility,” and “Adequacy” on the Dependant Variable “Rule Compliance with Rule 2”

	<i>B</i>	β	<i>r</i>	sr	<i>p</i> -value
Sanctioning costs	0.183	0.210	0.492	0.178	0.047*
General norm orientation	−0.053	−0.064	0.143	−0.068	−0.775
Social norm	0.037	0.045	−0.149	0.035	0.787
Distributive justice	0.124	0.138	0.359	0.143	0.050*
Procedural justice	−0.169	−0.194	0.056	−0.097	0.144
Informational justice	0.175	0.265	0.347	0.121	0.039*
Compatibility	0.437	0.443	0.437	0.397	0.000**
Adequacy	−0.014	−0.088	0.023	−0.093	0.479
Constant	4.566				0.001**

$R = 0.837$; $R^2 = 0.700$; adjusted $R^2 = 0.567$; $F = 5.255$, $p = 0.002$; ($df = 26$); $n = 47$; Durbin–Watson = 1.8; r (correlation); sr (partial correlation)

* $p \leq 0.05$

** $p \geq 0.01$

more severe the sanctioning costs are perceived, the more rule compliance has been recorded.

Rule 3: Appliances with High Energy Consumption Should Only be Used During the Day

There are differences in the frequency of compliance with the third rule, too. Because of the small sample size ($n = 16$) regression analysis with as many as eight explanatory variables leads to distortions, so that in a first step only correlations and partial-correlations were calculated. A model was then calculated only with the variables significantly related to the frequency of rule compliant behavior. Table VI shows the regression analysis with two explanatory (independent) variables that were able to explain most of the variance in rule compliance in this small sample.

This model is able to explain 64% of the variance in rule compliance. Again, compatibility is an influential factor. There is an even stronger association between the general norm orientation and the frequency of rule compliant behavior. Households with a strong norm orientation do not violate the third rule as often as households with a weaker norm orientation.

Table VI Regression of the Independent Variables “General Norm Orientation” and “Compatibility” on the dependant variable “Rule Compliance with Rule 3”

	<i>B</i>	β	<i>r</i>	sr	<i>p</i> -value
General norm orientation	0.762	0.735	0.818	0.410	0.006**
Compatibility	0.206	0.343	0.673	0.338	0.032*
Constant	1.190				0.061

$R = 0.825$; $R^2 = 0.706$; adjusted $R^2 = 0.640$; $F = 7.286$; $p = 0.046$ ($df = 12$); $n = 16$; Durbin–Watson = 2.8; r (correlation); sr (partial correlation)

* $p \leq 0.05$, ** $p \geq 0.01$

Rule 4: Refrigerators Have to be Disconnected from 6 to 10 p.m.

Only one household and the doctor were affected by this rule during our study. With only two cases, no statistical analysis could be conducted. However, in both cases, incompatibility seems to have caused occasional non-compliance.

Sanctioning Costs, Compatibility, and Adequacy (Hypothesis II)

Table VII shows the results of the correlations between sanctioning costs and sanctioning possibility \times severity, between compatibility and household characteristics, and between adequacy and perceived state of the resource, calculated for rules 1–3 (rule 4 has a too small sample size).

Based on existing theory, we analyzed whether individual perceptions of sanctioning costs are based on the perceived possibility of non-compliant behavior being detected and the severity of expected sanctions. For every rule, the possibility of being detected and the severity of the sanctions were rated separately. A variable constructed of these values multiplied was compared with the perceived sanctioning costs of the rule. Correlation with the values of rules 1–3 show significant relations between the multiplied value of the perceived possibility of non-compliant behavior being detected and the severity of expected sanctions, and the sanctioning costs.

Explorative correlation analysis between various household characteristics and perceived compatibility shows that especially households with many school-age children perceive the first rule (prohibition of irons and washing machines) as incompatible. The second rule (prohibition of light bulbs of more than 40 W) was rated as incompatible especially by households with many members getting up early in the mornings. Households with many children and

Table VII Correlations Between Sanctioning Costs and Sanctioning Possibility \times Severity, Between Compatibility and Household Characteristics, and Between Adequacy and Perceived State of the Resource, Calculated for Rules 1–3

	Rule 1	Rule 2	Rule 3	Rule 4
Possibility \times severity	Sanctioning costs 0.45*	0.61**	0.39*	–
Household characteristics				
Number of children	–0.38*	–	–0.42*	–
Time getting up	–	–0.36*	–	–
Frequency of visitors	–	–	–0.50*	–
Adequacy				
State of the resource	0.59*	0.32*	0.09	–

* $p \leq 0.05$, ** $p \geq 0.01$

households who often receive visitors more often perceive the third rule (high-consumption appliances must only be used during the day) as incompatible. People who thought that the state of the resource had been good (failures have not occurred very often) in the 2 weeks prior to the investigation period more often rated the first and second rules as adequate.

Discussion

Various factors influence compliance with rules for energy management. However, which factor, and to what extent, depends on the particular rule.

Individual Rule Compliance in Santa Maria

So far, community residents have always followed the *first rule* (prohibition of irons and washing machines). Of course, only few residents could actually buy these expensive appliances. Compared to the other rules, though, this rule is perceived as less compatible with daily routines and less legitimate. Energy consumption in general has still not exceeded energy production so that there is normally a surplus of stored energy. Many people favor the idea of a public laundry room and would like to loosen the rule so that some villagers could buy the appliances and share them with their neighbors. However, use rules would have to be introduced. Washing machines and irons are highly desirable because laundering work clothes and school uniforms by hand is hard work, which might be the reason families with many school-age children perceive this rule as especially limiting (hypothesis II). Additionally, the fact that rule was not introduced by the community but by the technicians that installed the MUS might cause the perception of low legitimacy. Still, people have obeyed this rule, and the analyses show that the social norm to follow the rule is perceived as strong and the sanctioning costs of breaking the rule are perceived as high. In fact, it is perceived as the “strictest” rule, and the opinion prevails

that rule breaking would be detected immediately and sanctioned severely. It is true that the social intimacy of the village would probably make it difficult to hide irons and washing machines.

Regression analysis explaining compliance with *rule 2* (no use of light bulbs of 40 W or more) has shown that compatibility, informational fairness, distributive justice, and sanctioning costs explained 57% of the variance in frequency of compliance. The prohibition of use of normal light bulbs (60–100 W) has been a serious limitation for many inhabitants, as energy-saving bulbs are hardly available, and fluorescent bulbs are more expensive. A donation of energy-saving light bulbs from the local government improved the situation, but some households still have to get along with fewer lamps than before. This incompatibility is apparently the strongest reason for breaking the rule. Further analysis (hypothesis II) showed that especially households with members getting up early in the mornings when it is still dark have broken the rule more often. Households who generally think that rule 2 leads to unjust energy distribution break it more often. The second rule seems particularly to limit those people who, besides lamps, do not possess other appliances. It is not surprising that poorer people do not like to follow this limiting rule. However, when the rule was introduced, the problem was discussed intensively and the mayor explained why the use of normal light bulbs is problematic, and told residents that non-compliance would lead to sanctions. This raised people’s awareness and provided further—although not as strong—reasons for complying with this rule.

General norm orientation and compatibility significantly explain the variance (64%) in compliance with the *third rule* (high-consuming appliances should only be used during the day). Due to the small sample size, only tentative conclusions can be drawn about these relationships, but the results can be seen as tendencies. The third rule has existed for many years and is well established. Perceived incompatibility, however, can still lead to non-compliant behavior. As further analysis especially shows (hypothesis II), households with many children and visitors

especially rated incompatibility higher than other households. Visitors from neighboring communities often come in the evenings, and this is also the time when school children spend most of their time at home. It might be incompatible that mixers (to prepare fruit juices) or rice cookers (to prepare dinner) cannot be used at this time. There is an even stronger association between a family's general norm orientation and compliance behavior. Comments by neighbors and the village mayor confirm that there are households who sometimes just “do not want to” follow rules. Those who have repeatedly broken the rule are described as having a certain tendency to non-conforming behavior. It is possible that people who do not care as much about rules as others are more likely to break such a well-established as the third one.

The two households affected by the *fourth rule* (refrigerators have to be disconnected from 6 to 10 p.m.) mentioned incompatibility making compliance difficult from time to time. They have sometimes forgotten to ask others to disconnect their refrigerators when they were not at home, and the doctor's unpredictable patient visits in the evenings make advance planning difficult.

General Conclusions

Comparing our results with other empirical findings, differences as well as parallels can be found. Many other empirical studies have also analyzed the importance of sanctions to enforce compliance of rules in common pool resource management. The probability of being detected and the severity of sanctioning as important components of sanctioning systems (Pfeiffer and Gelau, 2002) can be confirmed by our study (hypothesis II). Sanctioning, however, is not commonly perceived as the only factor to enforce rule compliance. In Santa Maria, sanctioning seems to enforce the first rule especially, because the probability of being detected is very high.

The only kind of (internal) pressure of importance for rule compliance was general norm orientation. Social norms, that is, the behavior of others, statistically did not have any influence. Non-compliance by others does not seem to be an incentive to do the same; in general there is disapproval of non-compliance. As rule compliance generally is quite high, the social norm of compliance might prevail. A low general norm orientation, however, was a strong determinant of non-compliance with the third rule. Pfeiffer and Gelau (2002) demonstrated in their studies that the general norm orientation was of importance when conscious decisions had to be made. The general norm orientation was not of relevance in automatic or unconscious decisions (such as driving through a red light at an intersection). The third rule in Santa Maria has existed for a long time, so that people have had time to think about it.

Non-compliant behavior as conscious behavior can therefore be partly explained through a low norm orientation.

The influence of legitimacy has been analyzed in several experimental and field studies in different areas: decisions by authorities in formal situations (such as jurisdiction) are more likely to be accepted if the persons involved perceive procedural and interactional justice (Colquitt, 2001, Tyler, 1994). Other studies show that procedural and interactional justice have a positive effect on worker commitment and organizational citizenship behavior among employees (Thompson and Heron, 2005; Williams *et al.*, 2002). In common pool resource management these aspects have been described as comanagement. Participation and transparency of information favored compliance with rules. Statistically, in Santa Maria less procedural justice (participation) than informational justice (transparent and adequate information) was perceived for all rules (see Table IV). Many of the residents in fact emphasized that whereas they want to be well-informed about the rules, it was not of such great importance to them to participate actively in the development of a new rule. Consequently, informational justice was more likely to influence rule compliance if perceived as insufficient. The low level of active participation might be explained as follows: The village mayor has an official order to maintain the MUS and to monitor energy consumption. The residents of Santa Maria—and Cuban society in general—respect such a status. Additionally, the mayor has been the village leader for a long time and knows the community very well. He has a lot of experience in understanding the dynamics of the MUS and in formulating adequate rules that are compatible with the demands of the community. Although it was not possible to explore the issue of interpersonal justice in a more open way, personal experience and informal conversations with the community members showed that the villagers have great confidence in the mayor's skill to develop adequate rules. Transparent information (e.g., through village meetings) and confidence in the village mayor therefore seem to be more important to the community members than active participation.

The inhabitants of Santa Maria expressed different opinions where distributive justice is concerned. Today, energy is allocated based on the quantity and type of appliances that people possess (which depends on their income). Most people, however, would prefer equal distribution or distribution according to individual needs. Because many share appliances with their neighbors, so far there have been no severe conflicts because of unequal energy distribution.

Contextual factors, such as compatibility and adequacy, have been shown to be important in studies of forest management (Horning, 2000; Marquette, 1998) and fisheries management (Honneland, 1999; Nielsen, 2003). These

have been important in these “real-world” studies because behavior in resource systems is often related to livelihood strategies, whereas contextual factors in Santa Maria are related to the comfort of everyday life.

Broader Perspectives

The theoretical background of our analyses is drawn from the findings of different theories and studies in different cultures. It is fair to assume that the factors underlying this study are of importance in the case of this Cuban community as well. However, it remains unclear if there are more specific values shaping compliance behavior in different societies. Only further studies can answer the question of whether there are factors explaining rule compliance not addressed in recent research.

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